INSTRUCTION MANUAL
for
X-Y Recorder Model F-5

Riken Denshi Co., Ltd.

理研電子株式会社

東京都目黒区祐天寺2丁目5番5号
電　話 (711) 6656 代

Model Name	F - 5	Section	

INSTRUCTION MANUAL
for
X-Y Recorder Model F-5

1. Summary

X-Y Plotter Model F-5 is equipped with the fully integrated circuit to make the entire apparatus conveniently portable in size and weight.

Complete temperature compensation would insure accurate operation under ambient temperature of 50°C, providing the following performance specifications:

(A) Unique electronic type modulator is employed to replace standard type mechanical chopper to convert DC input voltage to AC for stable, trouble-free operation.

(B) Carrier frequency, other with the power frequency is adopted for AC amplification to be highly stable against any external noise.

2. Specifications

CHART SIZE	Nominal	250 x 180 mm (A4)
INPUT SENSITIVITY	11 Ranges	0.5, 1, 5, 10, 50 mV/cm
		0.1, 0.5, 1, 5, 10, 20 V/cm
LINEARITY	within	0.3 %
ACCURACY	within	0.4 %
INPUT IMPEDANCE	See table	
RESPONCE	1 sec/250mm	
PHISHICAL DIMENSIONS	348 W x 267 D x 94 H	
	5.5 Kg	
POWER REQUIRED	220 V	50 Hz
	10 W	

The table for input impedance

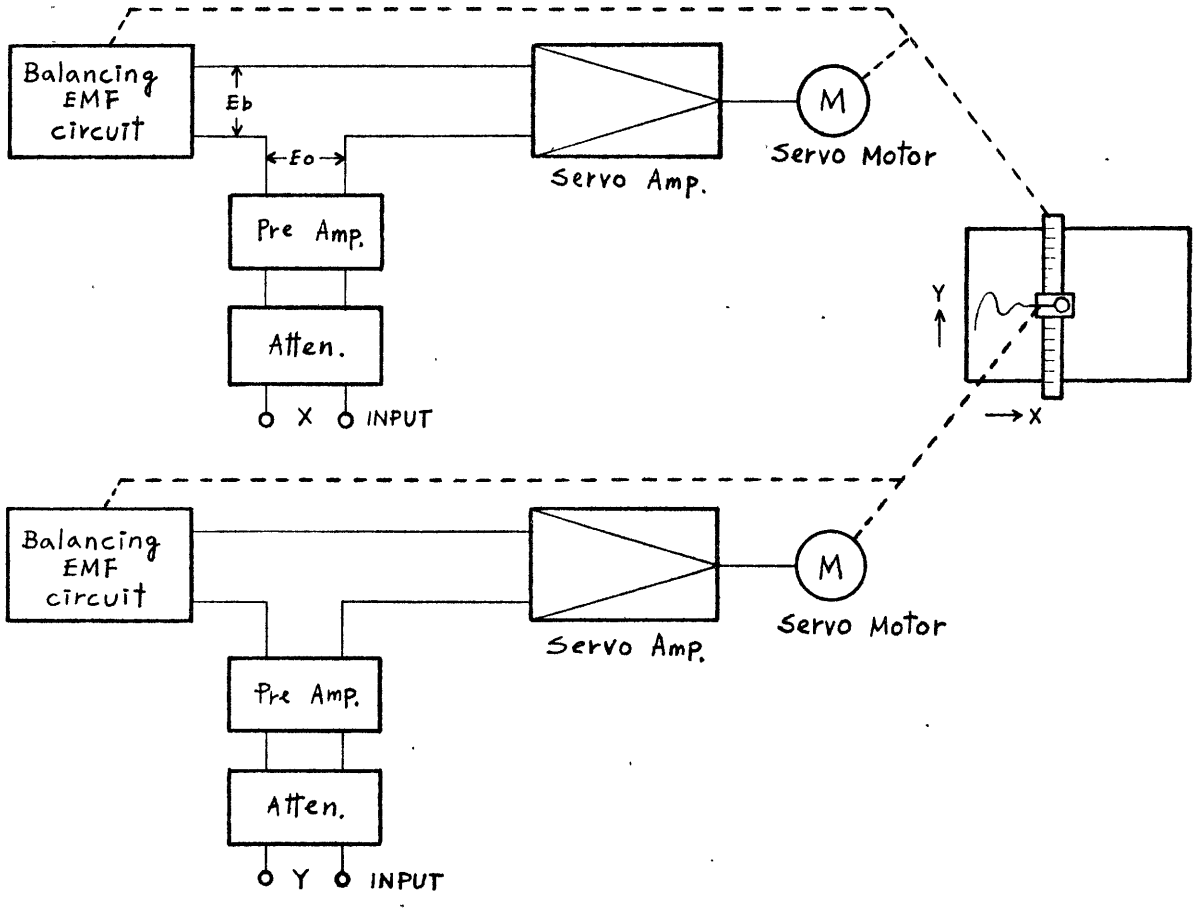
Range	Input Impedance	Range	Input Impedance
0.5 mV/cm	5 MΩ	0.1 V/cm	2 M
1 "	5 MΩ	0.5 "	2 M
5 "	200 K	1 "	2 M
10 "	400 K	5 "	2 M
50 "	2 M	10 "	2 M
		20 "	2 M

Model Name	F - 5	Section	

3. Principle

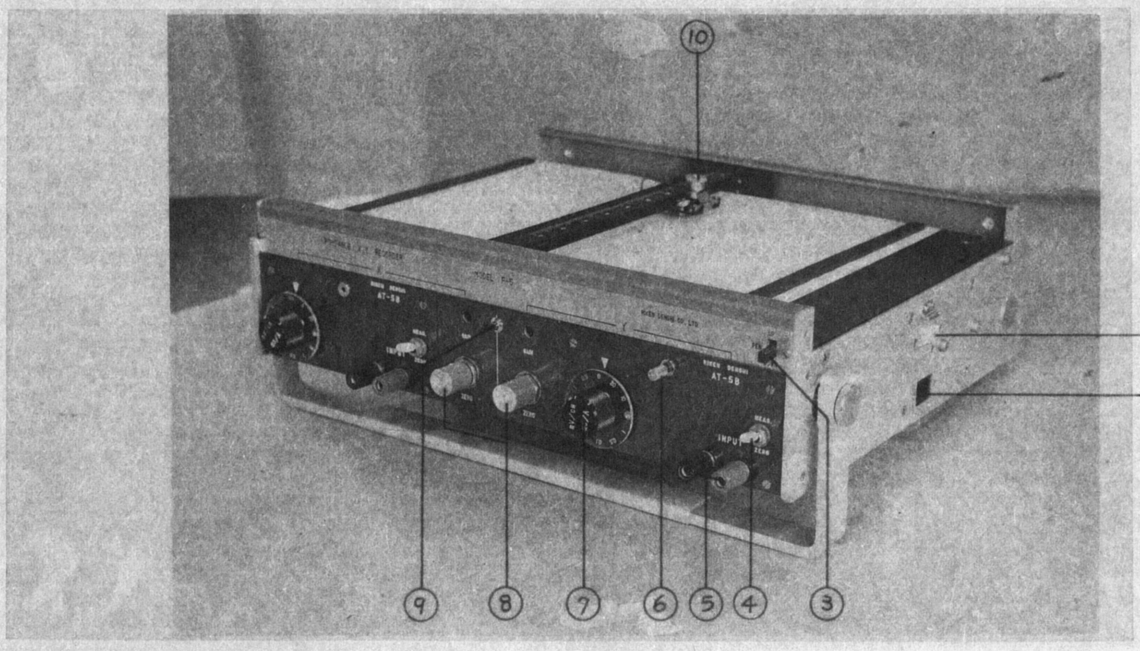
The recorder circuit has two component, i.e., DC preamplifier which amplifies very small signal to the adequate level, and potentiometer type auto balancing circuit which would balance output DC voltage and standard voltage.

Namely, DC input voltage can be converted to AC voltage by DC-AC modulator. Converted voltage can be amplified and synchronously rectified by a high-gain amplifier and fed back to the input for the balancing circuit. Output (Eo) of the pre-amplifier can be supplied to the potentiometer type balancing circuit as signal. The voltage difference between the balancing voltage (Eb) of the potentiometer circuit and the output (Eo) can then be amplified by the servo amplifier. The direction of the servo motor rotation will be subjected to vary depending on whether the difference markes negative or positive. The operation would stop when Eo = Eb. If the pointer is connected according to the rotation of the brushes of potentiometer, the movement of the pointer can be made to correspond with the magnitude of input voltage.

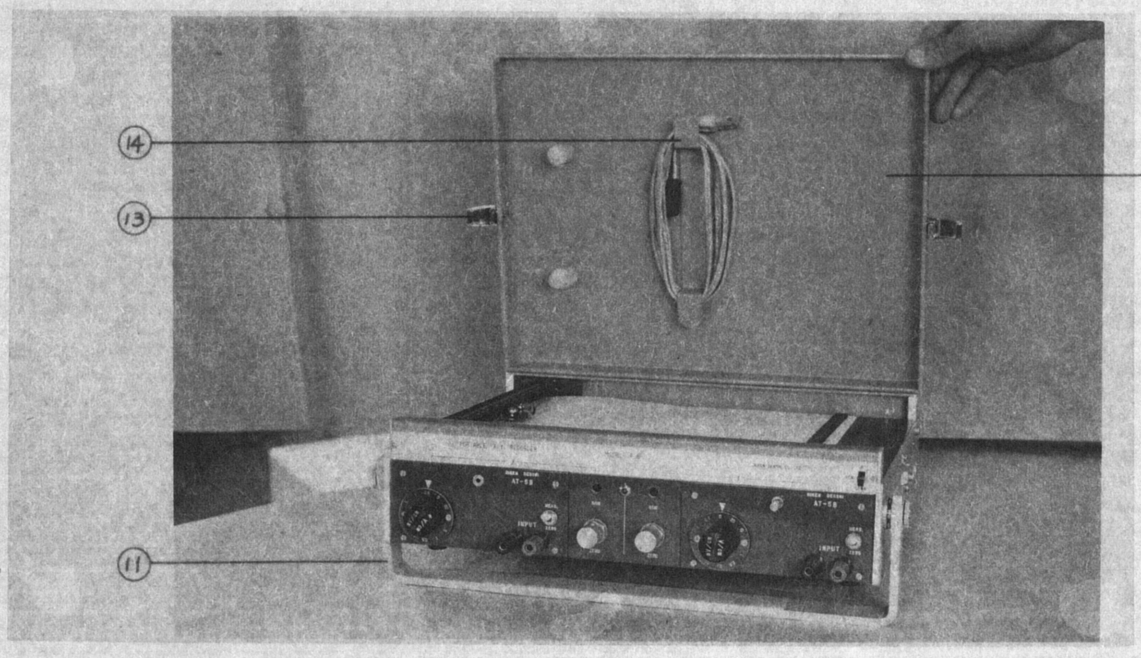


Model Name	F - 5	Section	

Illustration of the Recorder



① Power connector
② Power switch
③ "Up-Down" switch of pen
④ Input switch
⑤ Input terminals
⑥ Lock knob
⑦ Range switch
⑧ Zero point adjuster
⑨ Pilot lamp
⑩ Pen



⑪ Carry handle
⑫ Cover
⑬ Cover lock
⑭ Cord holder

Model Name	F - 5	Section	

4. OPERTION

4.1 Preparation

A) Set to "ZERO" input switch ④

B) Set pen UP-DOWN control ⑧ to "UP"

C) Throw power switch ② to "ON"

Note It take about 10 seconds till the recorder start to work due to the delay switch keep the power to motor off untill the pre-amplifier stable the output.

4.2 Chart setting

Set A4 sized graph paper so as to indicator coinside with the graduations of seale and put magnets to fix the chart.

4.3 Zero point setting

Set the zero point to the required point by adjusting zero controlling dial ⑧

4.4 Connection with signal to be measured

connect the signal to input terminals.

Note Input terminals ⊖ are floated from body through 1 μF capacitor.

It is better for keeping good response time and decreasing dead zone to be the internal resistance of signal circuit as low as possible.

4.5 Range switch setting

Set range switch ⑦ to the suited range in accordance with the level of input signal.

4.6 Pen

Throw Pen UP-DOWN switch ⑧ to "DOWN"

4.7 Recording

Throw INPUT switch ④ to "MEAS".

Model Name	F - 5	Section	

5. TROUBLE-SHOOTING

5.1 Judgment of Recorder Trouble

Disconnect the input circuit and vary the Zero adjustment volume to see if the pointer works without any trouble. If the pointer returns to the original position without any indication of an insensitive region when pushed slightly to the left or the right, chances are about 95% that the trouble is not in the recorder, but rather probably caused by misconnection of the external circuit or ripples of its power supply.

Therefore, if instability or an insensitive region is observed upon connection of the measuring circuit, recheck the external circuit itself.

5.2 In Case Recorder is Inoperative with Power Switch at "ON"

A. Check and see if the fuse works properly.

B. Check and see if the power connector is connected.

5.3 In Case Pointer or Arm Runs Over-Scale Even Though Measuring Range Switch Is at "SHORT"

(Disconnect all lead wires from the input terminal, etc.)

Check and make sure if the volume of the zero adjuster is laid in proper position.

5.4 In Case Pointer or Arm Moves Sporadically or Display an Insensitive Region Even Though Balanced

Check and see if the internal resistance of the measuring circuit is not too large (the external masuring circuit should be connected).

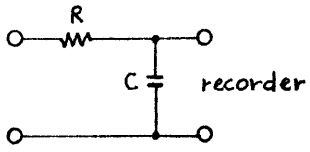
Pick-up resistance should be made as small as possible, since the higher the resistance between the input terminals (at the lowest measuring range), the more susceptible the amplifier to interference by electrostatic or electromagnetic induction.

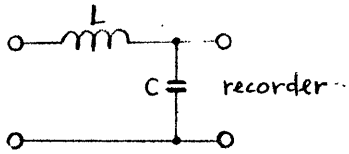
5.5 In Case Ripples Are Contained in the Measuring Circuit

Check and see if the power supplied to the circuit to bemeasured in smooth. If it is a rectified source and especially if it is

Model Name	F - 5	Section	

also the same with power supply to be recorder (50 Hz ~ 60 Hz), ripples due to incomplete smoothing are amplified with the signal and cause noise, reducing output variation and changing its phase, so that the recording will not operate properly.





Suggestions for Inprovement

A. Attach an R.C. integrating circuit or L.C. filter circuit with a reasonable time constant to eliminate the ripples.

B. Ground the ⊕⊖ terminals of the input circuit either directly or through a condenser of 1 to 10 μF to eliminate small ripples.

(This should not be attempted when one terminal of the power supplied to the external circuit is grounded.)

5.6 In Case Pointer Vibrates and Is Unstable

A. Check and see if the potential of input circuit terminals are too high in proportion to the ground.

B. Check and see if the grounding of body is complete.

C. Check and see if the filter in the input circuit is in perfect condition.
If it is not, ripples in the input will be amplified and cause the motor to vibrate.

D. Check and see if the contact of balancing slidewire is complete.

5.7 Instructions for Connection to External Circuit

Balancing recorders, which are capable of high gain amplification, are extremely sensitive to the condition of the power supply to the input circuit, the magnitude of input impedance, and the potential of the input circuit in proportion to the ground. If even a small signal other than the phenomenon to be measured is mixed into the input circuit, the recorder may display indication

Model Name	F - 5	Section	

error, change in the follow-up speed, increase in the insensitive region, or indicational instability.

Check for the following troubles in this case:

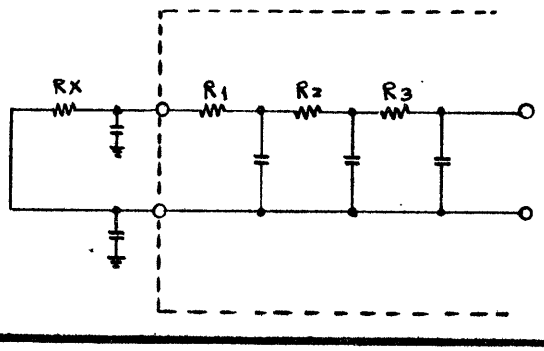
A. Error due to leak current from the positive terminal of the measuring circuit or the power supply to the recorder.

B. Ripplis from the power supply mixed in the input signal to be measured.

Error of type (A) is caused, for example, when a leak current gets into the input circuit and is chopped and added to the signal. Therefore, when measuring current, (for instance, when measuring the output current of a vacuum tube circuit) connect the terminals on the cathode side instead of the plate side.

If ripples from the power supply are mixed in the input signal to be measured, as in case (B) above, attach a filter circuit as shown in the figure. In either case, connect the external circuit, bearing in mind, the following points:

* Ground the recorder from its earth terminal.
  If possible, ground the ⊖ terminal of the recorder as well. But if this is impossible because of the nature of the power source of the circuit to be measured, ground it through a condenser of 1 to 10 μF. This is necessary in order to prevent any hum from entering the input circuit.
* Make the output impedance of the measuring circuit as small as possible.
  Also keep the output impedance below 1 KΩ at the minimum measuring range of the recorder. If it becomes necessary to measure a signal with a high impedance output, do not forger to ground the input terminal through a condenser. However, as the external resistance (Rx in the diagram) increases, the sum $Rx + R_1 + R_2 + R_3$ increases, thus increasing the time constant determined by the combination of C_1 and C_2 and causing the damping characteristic of the recorder to deteriorate.



Model Name	F - 5	Section	

6. SUGGESTIONS FOR BETTER MAINTENANCE

6.1 To insure accurate measurement, do not place the recorder in the following places:

* Places with strong vibration.
* Places filled with dust and corrosive gases.
* Places with viriable temperature.
* Places with high humidity.

6.2 Lubricate the bearings and rotating parts of the recorder once in a while with oil of low viscosity such as silicon oil, typewriter oil or watch oil.

6.3 Cover the recorder to keep off dust, when not in operation.

6.4 In case have adhered the ink on pen, pointer and rail, take off it and keep always cleanly.

6.5 To inspect the inside of the recorder, loosen the 4 screws on the corners of the case and pull out the case.

SCHEMATIC - MAIN PARTS LIST

MODEL F - 5

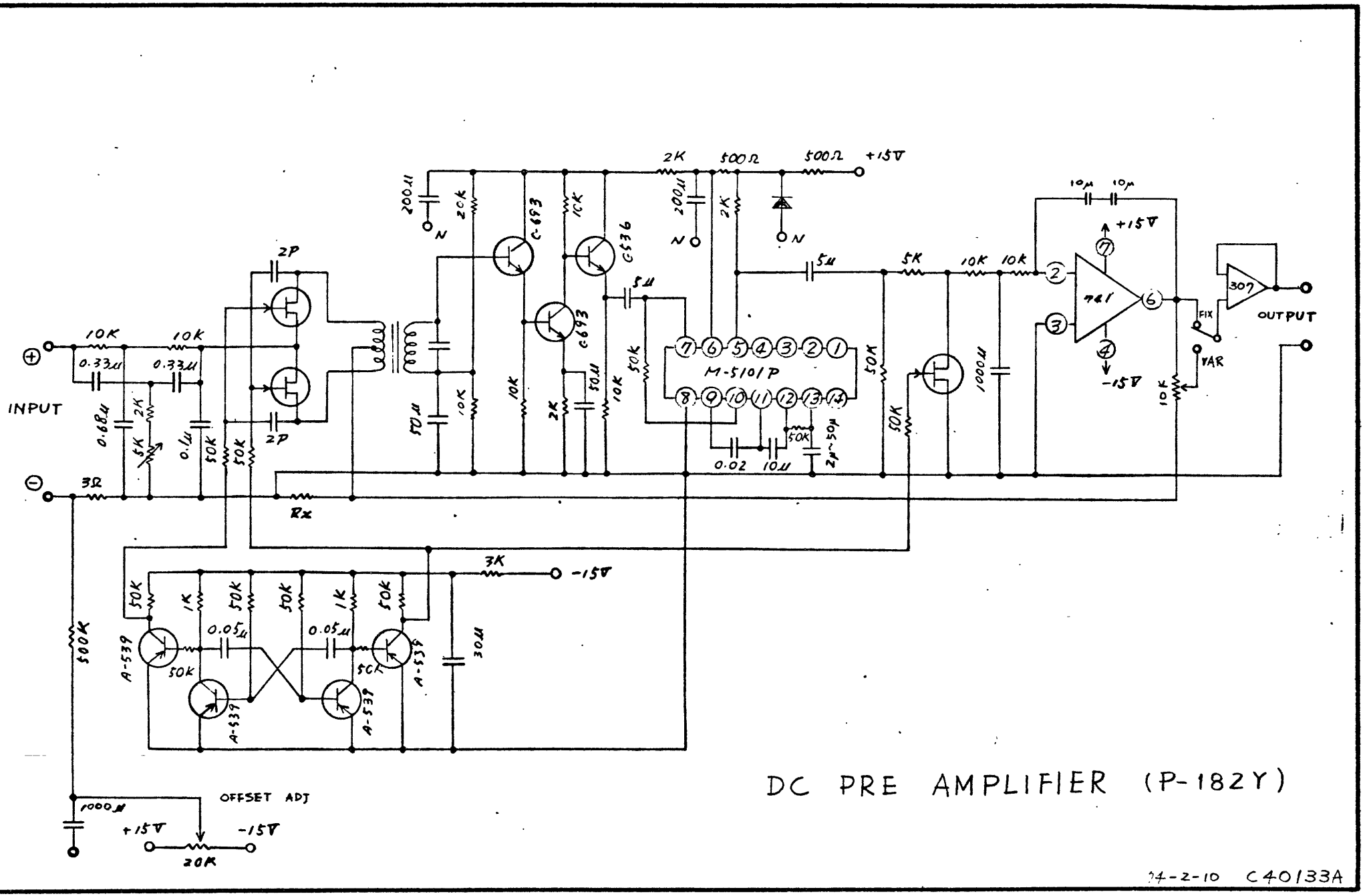
Riken Denshi Co., Ltd.

理研電子株式会社

東京都目黒区祐天寺2丁目5番5号

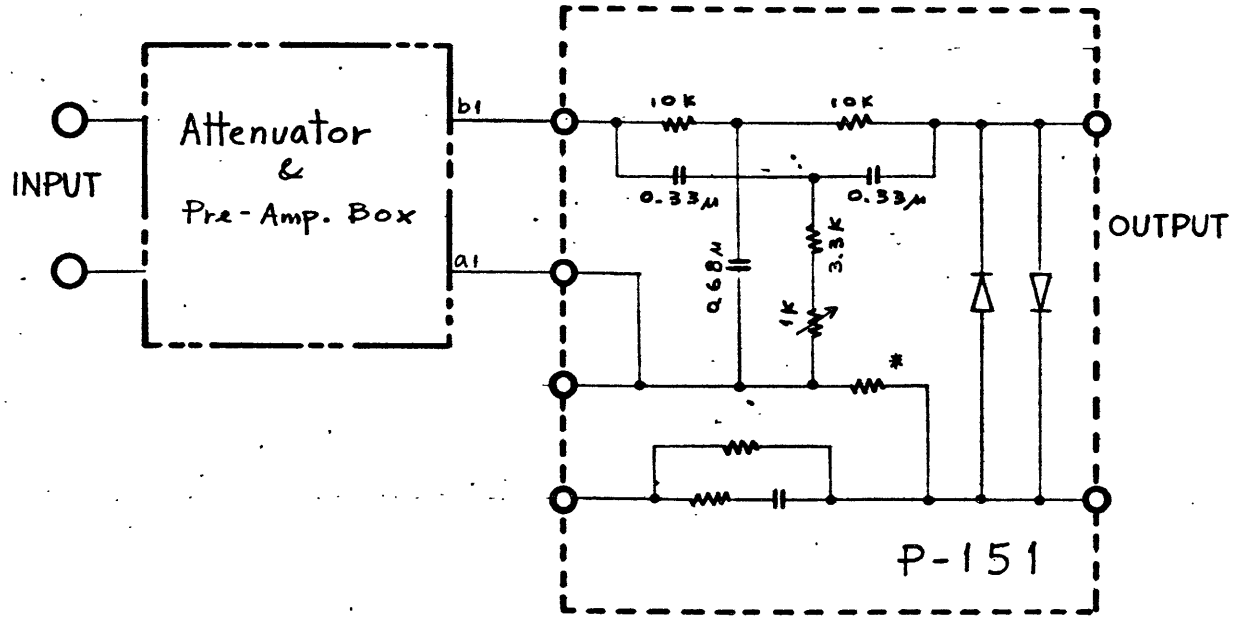
電　話（711）6656 代

Item	Printing board	Functions	Specifications	
1	P-182Y	* Chopper stabilized high gain D.C. Pre-Amplifier	Input D.C. level 1 ~ 10 mV Output D.C. level 100 mV D.C. gain 20 ~ 40 db max. noise level below 0.5μV	
2	P-151	* Paralel T noise filter	Frequencies 50, 60 Hz Reduction level -40 db	
3	P-150	* Main D.C. servo power amplifier * Balancing resistance * Damping circuit	Gain 60 db	
4	P-143B	* D.C. power supply ±15 V regulated power supply	Main D.C. power 24 V Regulated power: regulation within ±0.5 % ± 15 V	
5	P-176A	* Protection of scale out when the power supplied	Delay time 6 ~ 8 sec.	
6	P-76	* Two channel standard voltage generator	Regulation within ±0.05 % Against the power variation ± 10 %	
7	DC-211B	* High gain low noise Pre-Amplifier Unit	0.5, 1, 5, 10, 50 mV/cm 0.1, 0.5, 1, 5, 10, 20 V/cm 11 ranges	



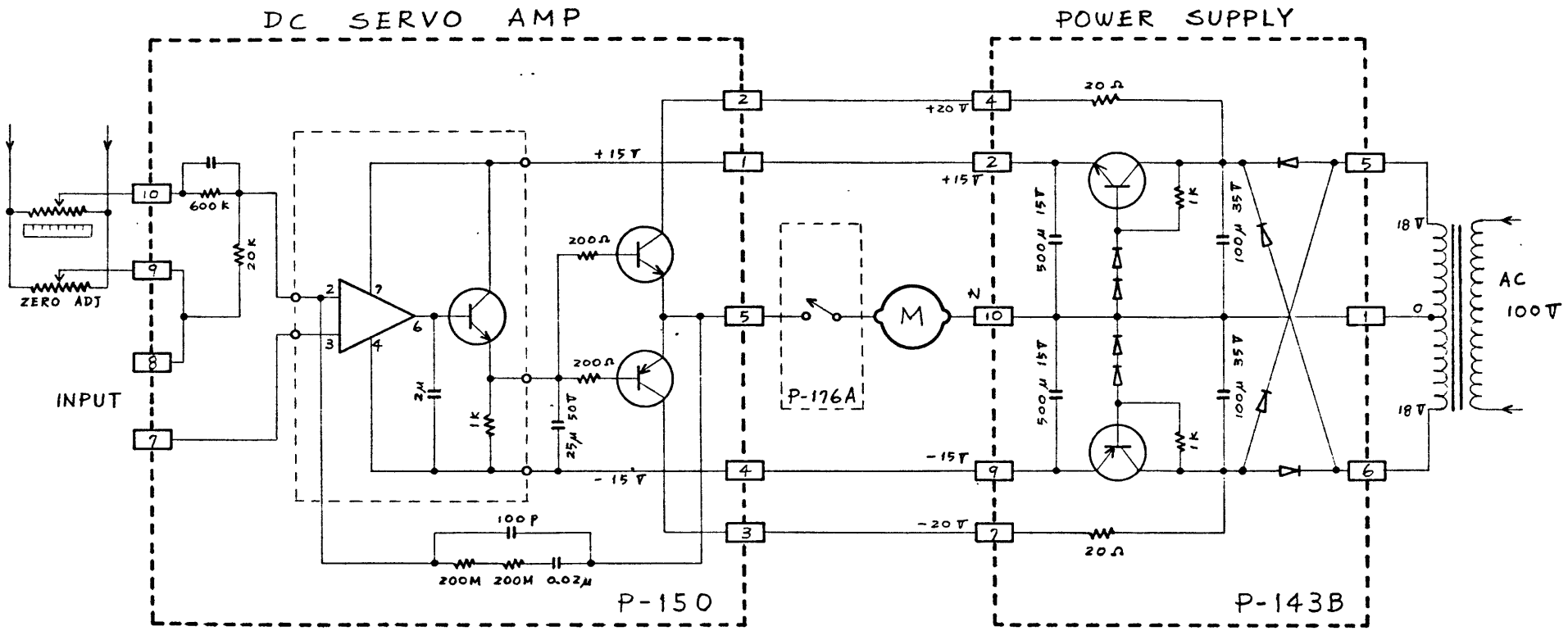
DC PRE AMPLIFIER (P-182Y)

74-2-10 C40133A



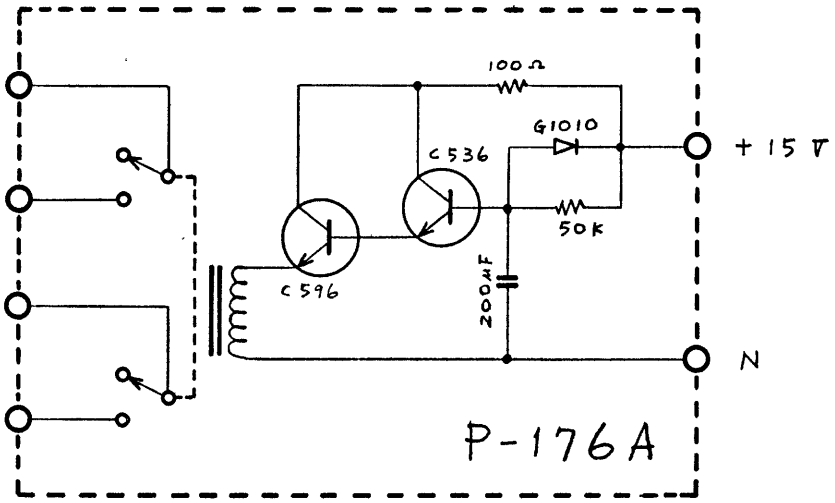
PARALLEL T NOISE FILTER

74-11-7 C40122B

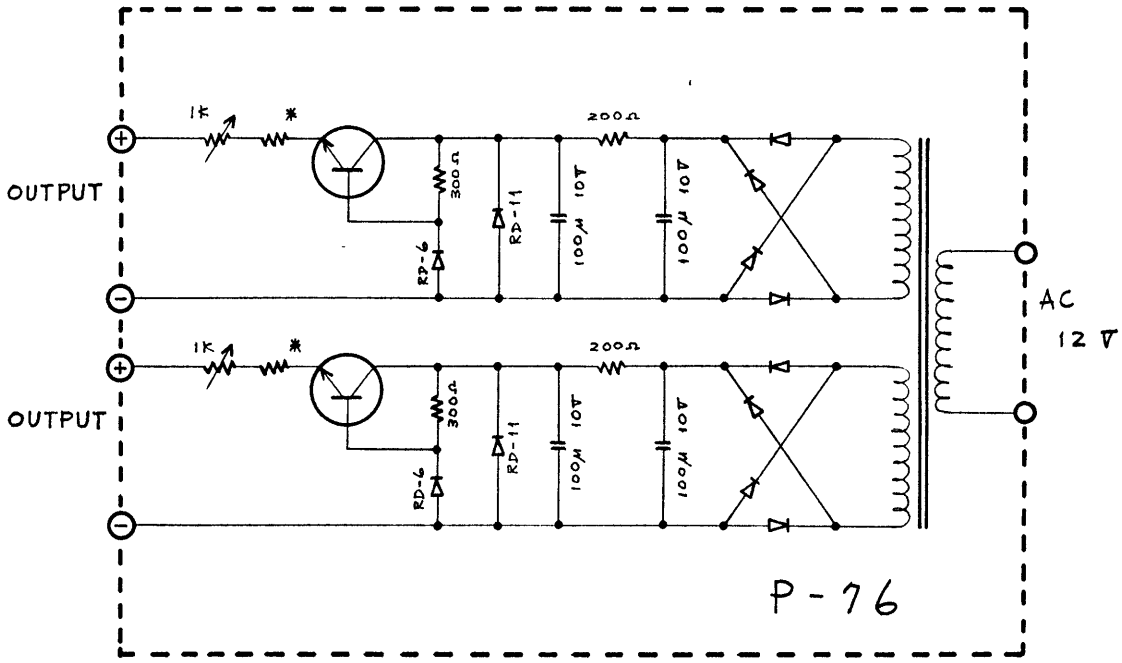


DC SERVO AMP & POWER SUPPLY

C40129 6-11-74



DELAY CIRCUIT

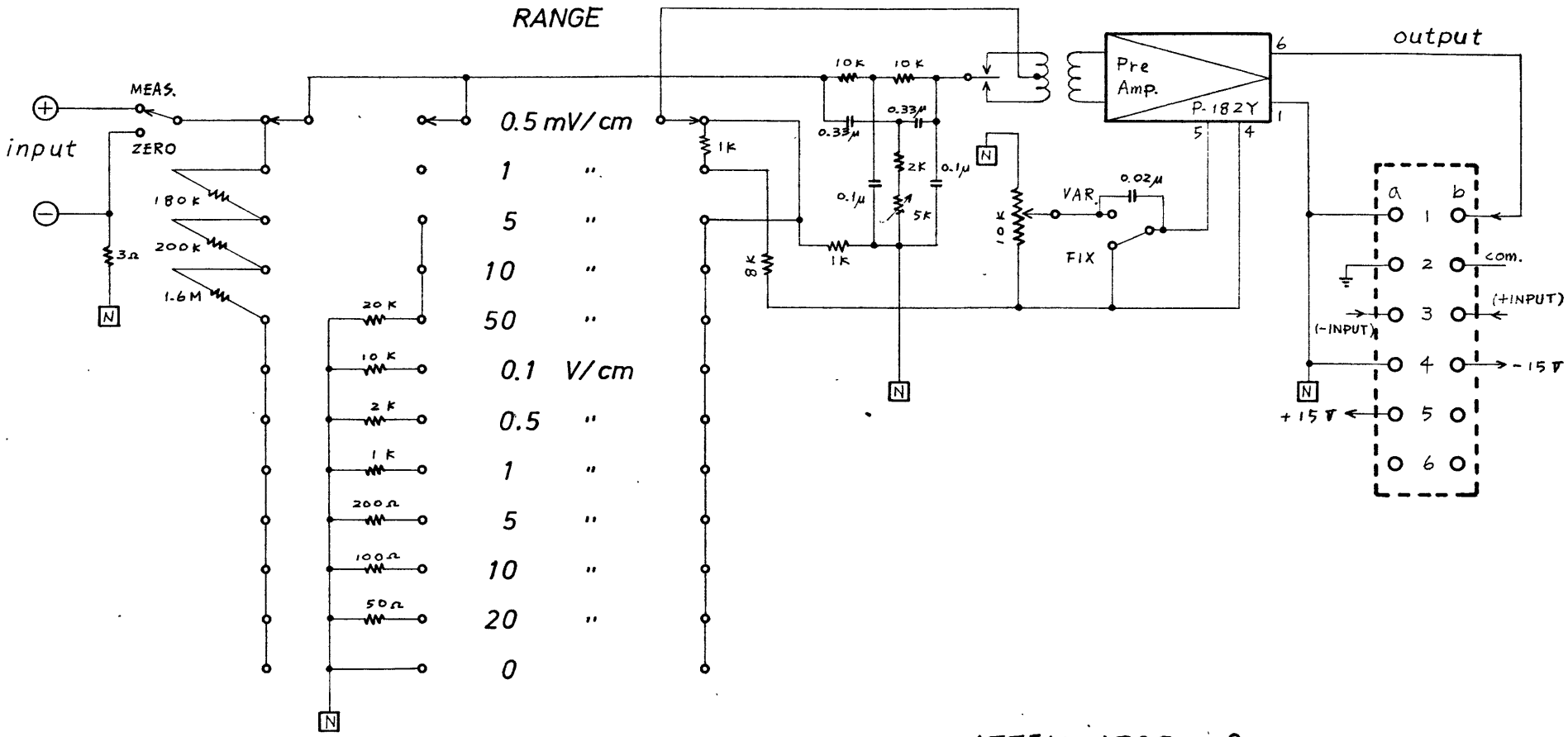


STANDARD VOLTAGE GENERATOR

RIKEN DENSHI Co., Ltd. No._____

Model Name	F - 5	Section	Main Parts List

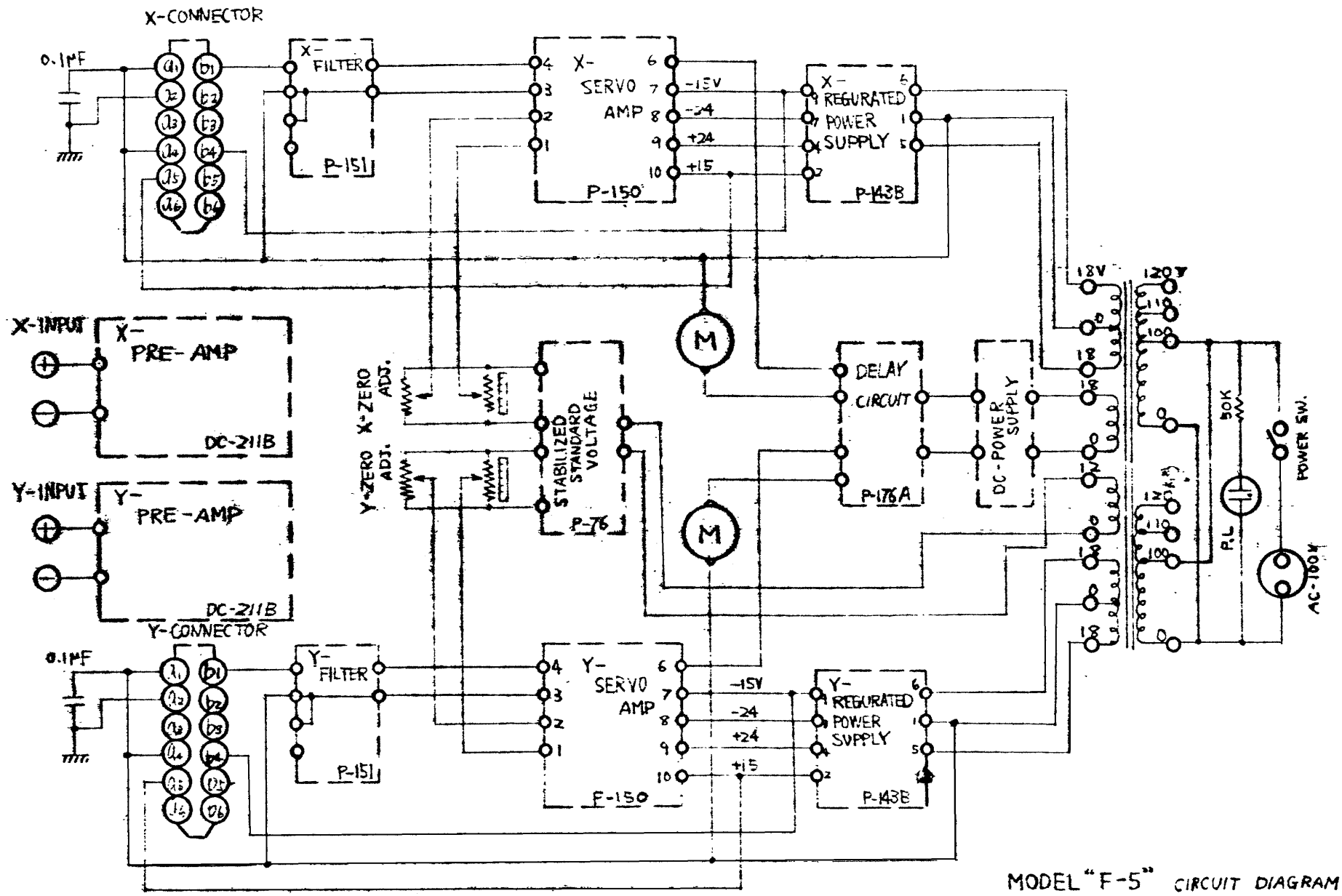
Item	Description	Specification
1	Power transformer	Secondary: 18-0-18 V 0.2 A 18-0-18 V 0.2 A 14 V 0.6 A 12 V 0.1 A
2	Balancing slide assembly unit	5 K ohms lin. ±0.3 % 3 turns W.W. potentiometer
3	Zero control variable resistor	5 K ohms lin. ±0.5 % 10 turns W.W.
4	Vernier variable resistor	10 K ohms lin. ± 0.5 % 10 turns W.W.
5	Servo motor	LC-118G D.C. 6 V 40 mA



ATTENUATOR &

PRE AMP. BOX DC-211B

74-12-23 C40120



MODEL "F-5" CIRCUIT DIAGRAM

Performance Data for

Model No F - 5
4121

Riken Denshi Co., Ltd.

理研電子株式会社

東京都目黒区祐天寺2丁目5番5号
電　話 (711) 6656 代

RIKEN DENSHI Co., Ltd. No._____

Model Name	F - 5	Section	The ability test

The ability test
(Model F- 5)

1. Input impedance ; X : 5000 K ohms at unbalanced condition.
   Y : 5000 K ohms at unbalanced condition.

2. Responce velocity : X : 1.0 sec. Full span.
   Y : 0.8 sec. Full span.

3. Dynamic response : 0.25 cycles full span.

4. Minimum input sensitivity : X : 2.5 mV
   Y : 1.8 mV

5. Accuracy : within ±0.4%

6. AC Supply voltage : AC 220 V 50 or 60 Hz 10 VA

7. Zero point : Can be set at any point of span both axes.

8. Chart size : JIS A-4 (180mm x 250mm)

RIKEN DENSHI Co., Ltd. No.

Model Name	F - 5	Section	The examination of lineality

The examination of lineality

4121

X Axis		Y Axis	
Standard value	Apointed value	Standard value	Apointed value
0 mV ×0.02	0.00	0 mV × 0.02	0.00
10 "	2.01	10 "	1.99
20 "	4.02	20 "	4.00
30 "	6.03	30 "	6.00
40 "	8.03	40 "	8.00
50 "	10.04	50 "	10.01
60 "	12.05	60 "	12.02
70 "	14.05	70 "	14.02
80 "	16.03	80 "	16.02
90 "	18.02	90 "	18.00
100 "	20.00		
110 "	22.00		
120 "	24.00		

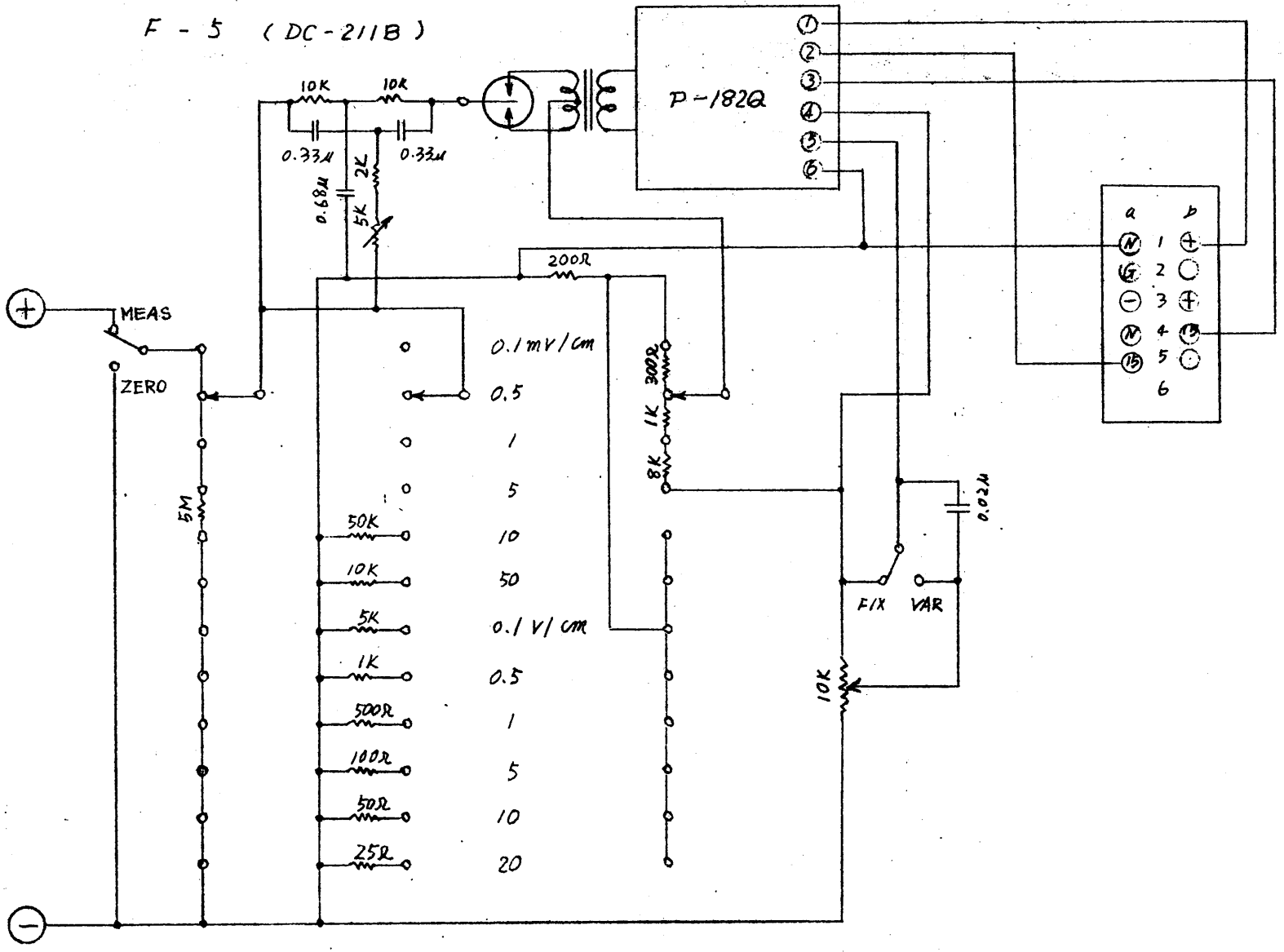
This examination was done in the condition as follows.

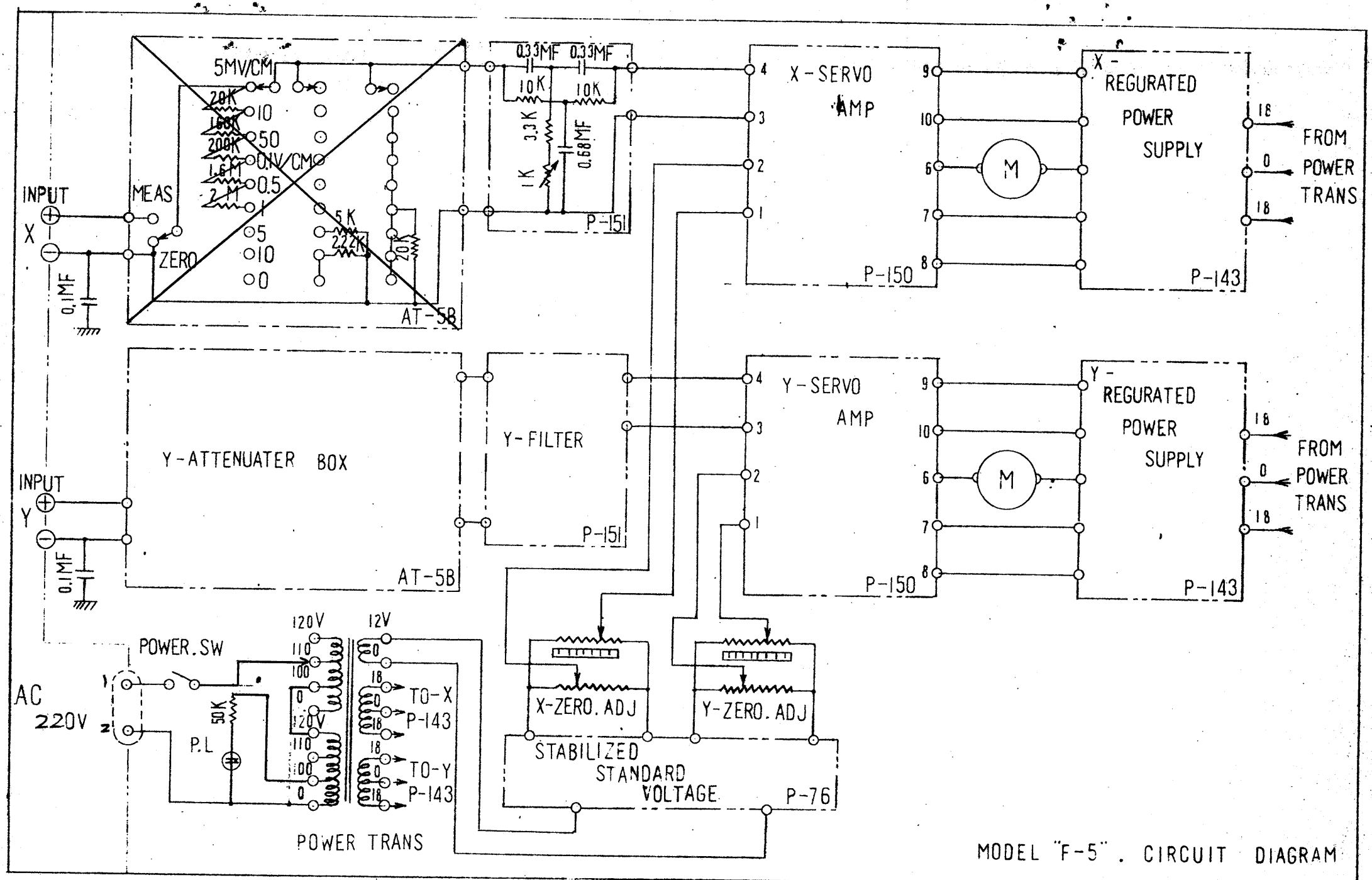
Temperature : 16 °C

Moisture : 54 %

The range of divider : 0.5 mV/Cm In this range the balance input impedance is infinite.

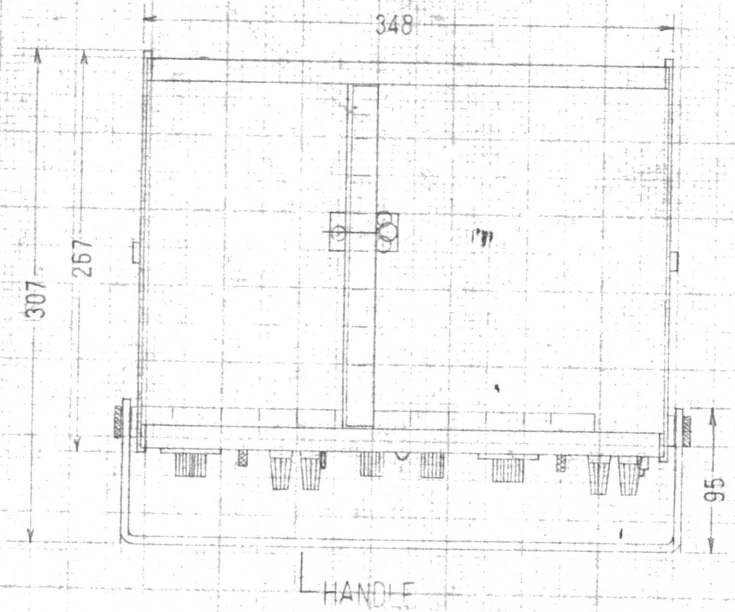
F - 5 (DC-211B)

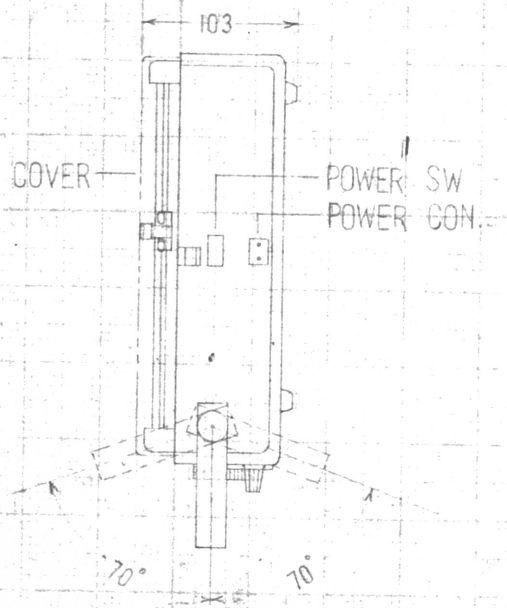

P-182Q
10K
10K
0.33μ
0.33μ
0.68μ
2K
5K
200Ω
MEAS
ZERO
5M
50K
10K
5K
1K
500Ω
100Ω
50Ω
25Ω
0.1mV/cm
0.5
1
5
10
50
0.1V/cm
0.5
1
5
10
20
300Ω
1K
8K
0.02μ
F/X
VAR
10K
a
b
N
G
N
1
2
3
4
5
6

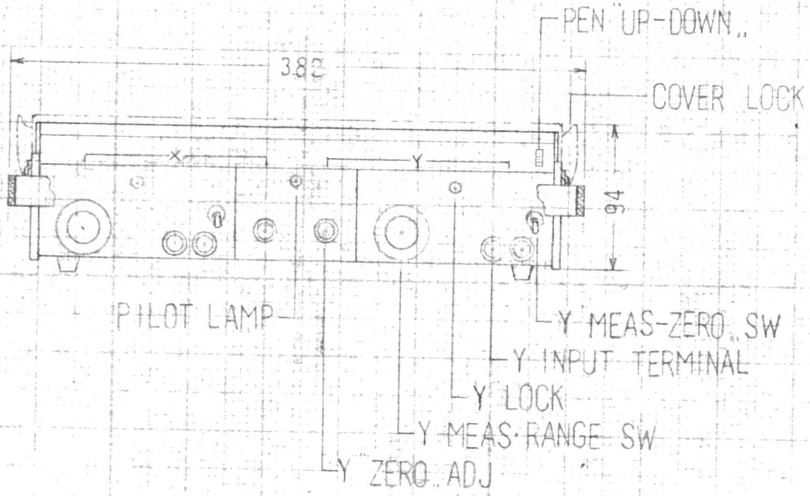


MODEL "F-5". CIRCUIT DIAGRAM

K-467







理研電子株式会社				
名称	"F-5" PORTABLE X-Y RECORDER 外形図			
承認		設計	S47-4-2	図番 137-100